

# HOST RELATIONSHIPS IN NORTH AMERICAN FUNGUS-FEEDING MOTHS (OECOPHORIDAE, OINOPHILIDAE, TINEIDAE)

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## ABSTRACT

Feeding habits and habitat preferences are discussed for 19 species of North American Microlepidoptera known to occur in wood-rotting fungi. A brief section on host fungi and the nature of the fungus substrate is followed by a general discussion of host ranges. Detailed biological information is included under each species. *Oinophila v-flava* and members of the Oecophoridae are considered to be general scavengers utilizing fungi occasionally, while the Tineidae include obligate fungus-feeders, occurring mainly in Polyporaceae. Among the Tineidae, some species (*Morphaga cryptophori*) appear to be host-specific, while others (*Nemapogon defec-tellus*) are ecologically restricted but utilize a number of host fungi. Certain fungus species, such as *Polyporus gilvus* and *P. munzii*, are frequently inhabited by tineids, while *P. versicolor* and certain others serve only as incidental hosts.

## INTRODUCTION

A fungus-feeding habit has long been recognized for certain Microlepidoptera, particularly Tineidae. Information about host relationships has been based mainly

on European species, and knowledge of the feeding habits of North American species has lagged far behind that of their Palearctic counterparts. Forbes (1923), for example, gives only a few unidentified host records for fungus-feeding tineids of the northeastern United States, and no fungus associations are given for Oecophoridae. There have been few subsequent reports to fill out this gap in our knowledge. In contrast, fungus hosts are known for a number of British oecophorids (e.g., Meyrick, 1895), and numerous rearing records are available for many of the European fungus-feeding tineids (Hinton, 1956; Petersen, 1957, 1958; Zagulajev, 1964).

In the course of a rearing program for insects, particularly Coleoptera, associated with Polyporaceae and other wood-rotting fungi, during 1960-1963, a number of tineids were reared from various polypores collected in Oregon, California, and Arizona. Although subsequent collections were made especially to obtain information on the moths, many of the records given below are by-products of a survey for Ciidae and other fungus-inhabiting Coleoptera. Consequently, owing to the rearing methods, moths were obtained primarily when nearly mature larvae were incidentally taken with the fungus sample. As a result, many of the collections produced only one or a few individuals, creating problems in the identification of the moths.

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Although many European species in these moth groups have been reared on a number of occasions, reports on these have often included only vague host identifications (i.e., "wood fungus," "fungus on oak," "bred from Polyporus"), and no effort has been made by previous workers to eliminate doubtful records or to analyze host ranges for individual moth species. During the present study we have stressed this aspect of the biology. Since there have been very few reports on North American species, there are no literature records that we have had to consider suspect.

All of the moths involved in this study feed on Polyporaceae, but for some of them the polypores appear to be only incidental hosts. Although some of the Oecophoridae are probably general scavengers, the tineids are for the most part obligate associates of wood-rotting Basidiomycetes. A few records are known from Ascomycetes. Schutze (1931) reported that *Nemapogon arcellus* (Fabricius) feeds in the small brown sporophores of *Hypoxylon fuscum*. During this investigation, a number of collections of *Hypoxylon thouarsianum* were processed, but the only tineids reared appeared to be incidental associates. One other species of Lepidoptera, a pyralid moth, was found to use *Hypoxylon* as a principal host (Powell, 1967). Several European species of *Nemapogon* have also become adapted to human habitats and may be found feeding in dried mushrooms, grain, dried fruit, and cork.

## TECHNIQUES

In most of the earlier collections, sporophores were removed from the substrate and brought into the laboratory. At times tineids may be reared in large numbers using this system, particularly when the sporophores are large, but additional field work during the years 1964-66 has shown that moth larvae are frequently located in the bark or other woody substrate underlying the fungal fruiting body. Most of our later collections have involved caged logs, branches, or bark chunks with sporophores

and sterile fungus tissue under the bark or protruding from cracks.

Wax-lined cardboard cartons to which moisture is added every few days have proved to be suitable housing for larger fungus collections. These cartons must be opened daily during periods of active emergence, because tineids do not consistently move out towards the light and into emergence vials, as do most moths. For smaller collections "Tupperware" trays with tight fitting lids proved effective in preventing moisture loss.

In addition to our own collections, we have included records from specimens bearing host labels the source of which could not be checked. Thus some of the records from older pinned specimens may not be accurate. In Table 1, a distinction is made between verified and non-verified host associations. In the sections presenting biological data, the abbreviations "emgd." (emerged) and "r.f." (reared from) are used. The number of specimens reared is not accorded special significance. In many cases, emergences of only one or a few individuals may be attributed to the conditions of collection or rearing, as explained above.

In our own collections (JFL and JAP lot numbers given in the data), representative samples of the fungi were separated and allowed to dry for identification purposes. Host determinations were provided by specialists cited in the acknowledgments. As the study progressed, we developed index collections of the fungi and identified some of the more common species ourselves.

## THE HOST FUNGI

Since an attempt will be made to determine the degree of host or habitat preference exhibited by fungus-feeding moths, it will be useful to examine the nature of the fungus substrate, the classification of the host fungi, their distributional and ecological ranges, and the possible factors which might be involved in the selection

TABLE 1. SUMMARY OF HOST RECORDS FOR NORTH AMERICAN FUNGUS-FEEDING TINEIDAE

Fungus species	↑	Hypoxylon thouarsianum	Armillaria mellea	Stereum hirsutum	Merulius americanus	Ganoderma applanatum	Ganoderma brownii	Ganoderma lobatum	Fomes pimicola	Fomes officinalis	Fomes ignarius	Fomes pini	Polyphorus gilvus	Polyphorus citrinatus	Polyphorus dryophilus	Polyphorus vulpinus	Polyphorus munzli	Polyphorus amarus	Polyphorus sulphureus	Polyphorus adustus	Polyphorus anceps	Polyphorus volvatus	Polyphorus versicolor	Polyphorus hirsutus	Lenzites betulina	Trametes hispida	Dacdalera mucostricta	Portia versipora	Fungus species	Verified records	
Nemopogon granellus		1					1						3	1					(2)					1					6	7	
Nemopogon molybdanellus		4				1	(1)		2	1	1		9						1	2	1	1	(1)					1	12	24	
Nemopogon apicisignatellus															1				2										2	3	
Nemopogon oregonellus																		2											2	2	
Nemopogon defecellus		1							(1)						1	1	4	(1)									1	(1)	6	8	
Homonotia maculatella					1								1		(1)				1										3	3	
Monopsis mycetophilaella													1						1		1								2	2	
Ceolestica sp.				1																									1	1	1
Monophaga cryptophori																						8	(1)						1	8	
Diataga leptosecles																1											1		2	2	
"Scardia" coloradella						1	1														1								3	3	
"Scardia" gracilis		1		1				1					7						1	1	1	1	2	1					9	16	
"Scardia" berkeleyella													1										1						2	2	
Number of moth species		3	1	2	1	2	2	1	2	1	1	1	5	2	2	2	1	1	5	3	1	3	4	1	1	1	1	1	1	X	X
Number of verified records		6	1	2	1	2	1	1	3	1	1	0	21	2	2	2	4	2	3	5	1	10	5	1	1	1	1	1	1	X	77
Total fungus collections		24	1	22	1	12	20	1	65	7	3	4	28	2	4	2	7	2	9	22	13	52	141	19	18	13	3	5	X	497	
Index of productiveness		.25	X	.09	X	.17	.05	X	.05	.14	X	X	.75	X	X	X	.57	X	.33	.23	.08	.19	.03	.05	.05	.08	X	.20	X	X	

of particular fungi as feeding or oviposition sites. All of the fungus species encountered in this study cause decay in woody plants, and, with the exception of the ascomycete *Hypoxylon thouarsianum*, they are advanced members of the Basidiomycetes (families Agaricaceae, Thelephoraceae, and Polyporaceae) in which the hymenium or spore-bearing surface forms part of a relatively large and persistent fruiting body or sporophore. Often the major portion of the fruiting body consists of sterile hyphal tissue and is called the context; it is this part of the sporophore which is utilized as food by many insect species.

*Classification.* In recent years several attempts have been made to revise the classification of the Polyporaceae and related families, using microstructure (Cunningham, 1965) and cultural characters (Nobles, 1958, 1965), in addition to the general habitus of the fruiting body and the characteristics of the hymenium and spores. At present, however, no system has been widely accepted; numerous generic names have been proposed, and the application of a particular name varies from author to author. Because of this confusion, some authorities, such as Lowe and Gilbertson (1961a, b), have found it more convenient to use the older concepts of Fries and others until an acceptable generic classification has been developed. Cunningham (1947) points out that many of the Friesian concepts are relatively useless, and he gives as examples certain species of polypores which vary to the extent that they could be placed in any one of five genera. Labels such as "ex *Polyporus*" or "ex *Fomes*" on fungus-bred insect specimens are of little or no value in determining host relationships and are excluded from consideration here. At the species level, however, the North American polypores are fairly well known, and several current manuals are available (Lowe, 1957, 1966; Lowe and Gilbertson, 1961a, b; Overholts, 1953).

The following is a list of host fungi from

which North American tineids have been reared:

#### ASCOMYCETES, XYLARIACEAE

*Hypoxylon thouarsianum* (Leveille)  
Lloyd  
(= *Hypoxylon occidentale* Ellis and  
Everhart)

#### BASIDIOMYCETES, AGARICACEAE

*Armillaria mellea* (Vahl) Quelet

#### BASIDIOMYCETES, THELEPHORACEAE

*Stereum hirsutum* Willdenow ex Fries

#### BASIDIOMYCETES, POLYPORACEAE

*Daedalea microsticta* Cooke  
*Fomes ignarius* (Linnaeus ex Fries)  
Kickx  
*Fomes officinalis* (Villars ex Fries)  
Faull  
*Fomes pini* (Thore ex Persoon) Lloyd  
*Fomes pinicola* (Swartz ex Fries)  
Cooke  
*Ganoderma applanatum* (Persoon ex  
Wallroth) Patouillard  
*Ganoderma brownii* (Murrill) Gilbertson  
*Ganoderma lobatum* (Schweinitz)  
Atkinson  
*Lenzites betulina* (Linnaeus ex Fries)  
Fries  
*Merulius americanus* Burt  
*Polyporus adustus* Willdenow ex Fries  
*Polyporus amarus* Hedgcock  
*Polyporus anceps* Peck  
*Polyporus circinatus* Fries  
*Polyporus dryophilus* Berkeley  
*Polyporus gilvus* (Schweinitz) Fries  
*Polyporus hirsutus* Wulfen ex Fries  
*Polyporus munzii* Lloyd  
*Polyporus sulphureus* Bulliard ex Fries  
*Polyporus versicolor* Linnaeus ex Fries  
*Polyporus volvatus* Peck  
*Polyporus vulpinus* Fries  
*Poria versipora* (Persoon) Romell  
*Trametes hispida* Baglietto

The genus *Merulius* has a doubtful place among the polypores and has been placed



in a separate family by some authorities; some species superficially resemble *Stereum* and other Thelephoraceae in having a thin context and relatively continuous hymenial surface (very shallow pores). The species of *Ganoderma* are all closely related and seem to form a natural group. The remainder of the polypores above represent a diverse assemblage, but at least three natural units can be recognized that do not correspond to the generic groupings presented here. *Fomes ignarius*, *F. pini*, and *Polyporus gilvus* have rather hard and woody, often perennial, sporophores in which the context is distinctly reddish brown or yellowish brown, turning black with the application of KOH solution; these species have been placed in the genus *Phellinus* Quelet by some authorities (Bondarzew, 1953). *Polyporus circinatus*, *P. dryophilus*, *P. vulpinus*, and *P. munzii* also have a brownish context that reacts similarly with KOH, but sporophores are annual, the texture is not as hard and woody, and older specimens tend to crumble; these species are sometimes included in the genus *Inonotus* Karsten. Nobles (1958) places both of these groups in the same section on the basis of cultural characters. *Polyporus versicolor*, *P. hirsutus*, *Lenzites betulina*, and *Trametes hirsuta* have a whitish or tan context with a fibrous or punky texture and a complex (trimitic) hyphal system; these and a number of other species seem to form a natural group that roughly corresponds to the genus *Coriolus* Quelet.

*The fungus substrate.* Two features shared by all of these fungi are: 1) their association with woody plants, and 2) the relative toughness and durability of the fruiting body. In contrast to the terrestrial members of the Agaricaceae and Boletaceae, these wood-rotting fungi usually occur off the ground on living or dead trees, logs, and stumps, and the fruiting body is less susceptible to water-logging and rapid bacterial and fungal decay. The context is often woody or fibrous, and even in the annual species the fruiting body may be

persistent throughout the year. As a result, the habitat formed is suitable for a number of Lepidoptera and Coleoptera which have a relatively long life cycle but are capable of feeding within a tough and often dry substrate. In addition, the base of the sporophore is continuous with the wood, which has been chemically altered by the fungus mycelium; this permits the occasional use of the fruiting body by insects which normally occur in rotting wood or conversely provides an alternate substrate for feeding or pupation by insect inhabitants of the sporophores. As mentioned above, a number of moth larvae have been found within the wood.

*Factors involved in host or habitat selection.* Important in the present study are those factors common to only one or a few of the fungi which might make them suitable for or preferred by some insect species but not others. These include the structure of the fruiting body itself, the type of rot produced in the wood, the characteristics of the host trees, and the nature of the general habitat in which the fungus is normally found.

One obvious character, briefly mentioned above, is the color of the sporophore, which is a reflection of its chemical composition. Lawrence (1967) and Paviour-Smith (*in litt.*) have found that certain species of the beetle family Ciidae occur only on those fungi with brownish sporophores. The species of *Ganoderma* and the *Phellinus* and *Inonotus* groups all have brownish fruiting bodies, while in all of the other polypores listed above, the context is whitish to pale brown and does not turn black in KOH. The fruiting body of *Armillaria mellea* has a light colored context, while *Hypoxyylon thouarsianum* produces a brownish sporophore, which turns black and cinder-like with age.

The texture of the fruiting body varies considerably, but it is often difficult to characterize. Paviour-Smith (1960) and Lawrence (unpublished data) have noted that a number of ciid beetles are restricted

to fungi with a trimitic hyphal system and a whitish or pale context (*Polyporus versicolor* and its relatives). It is possible, however, that the nature of the hyphal system is not directly correlated with texture, and the type or extent of extracellular adhesive material or the thickness of the hyphal walls may be as important as the presence of binding hyphae. This matter is complicated by the fact that texture (as well as chemical composition) varies with age and moisture conditions. In some species (*Fomes pinicola*, the *Phellinus* group) older specimens become hard and woody, in some (*Ganoderma*, the *Coriolus* group) they are firm but fibrous or punky, in some (*Inonotus* group) they may be more loosely fibrous, tending to break up easily, and in others (*Polyporus sulphureus* and *Fomes officinalis*) they may be chalky or friable. In his discussion of the successive changes taking place in the fruiting bodies of polypores, Graves (1960) makes a distinction between those sporophores growing in wet conditions (stage 4b) and those which have been allowed to dry out (stage 4a). In a fungus such as *Ganoderma applanatum*, there is a distinct difference between wet and dry fruiting bodies, and this is reflected in the composition of the insect fauna.

The size and thickness of the sporophore and its persistence determine the amount of food available to sustain the insect population when the wood cannot be used as an alternative substrate. Species of *Fomes* and *Ganoderma* often produce massive fruiting bodies which are often perennial, forming new layers each year; sporophores of most of the other species are annual and vary in size. In *Stereum* and *Merulius* the context is very thin, in *Polyporus adustus*, *P. gilvus*, and the *Coriolus* group it is somewhat thicker, and in *P. amarus* or *P. dryophilus* it may be quite thick. Some species, such as *P. gilvus* and *P. adustus*, have relatively small fruiting bodies, but large numbers of them often occur together connected by sheets of sterile tissue; in other species,

such as *P. volvatus* and *H. thouarsianum*, they are always small and isolated from one another. Although *P. sulphureus* or *Armillaria mellea* are usually ephemeral and the woody *Fomes* usually persistent, it is difficult to determine the relative durability of most fruiting bodies because of the effects of moisture conditions, bacterial and fungal breakdown, and the damage produced by the numerous species of fungus-feeding insects.

Most species of polypores have relatively wide host ranges, but a few are host specific and most others occur primarily either on gymnosperms or angiosperms. The two types of decay produced are the white or delignifying rot and the brown or carbonizing rot. *P. amarus* occurs exclusively on *Libocedrus decurrens*, where it causes a brown rot, *P. vulpinus* and *P. munzii* produce white rot in *Populus* and *Salix*, and *G. brownii* usually grows on living or dead *Umbellularia californica*. The species occurring primarily on gymnosperms are *M. americanus*, *F. pinicola*, *F. officinalis*, *F. pini*, *P. circinatus*, *P. sulphureus* (in western North America), *P. volvatus*, and *P. anceps*; of these *F. pinicola*, *F. officinalis*, and *P. sulphureus* produce brown rots. *P. gilvus*, *P. dryophilus*, *P. versicolor*, and the rest of the species listed above occur primarily on angiosperms, and all produce white rots.

Since little work has been done on the detailed distribution or local abundance of fungus species, notes on the general habitat must be based mainly on our own observations and restricted to the more common species. *H. thouarsianum*, *S. hirsutum*, *P. dryophilus*, *P. gilvus*, *P. adustus*, and *P. versicolor* are all fairly common on *Quercus* and other hardwoods in mesic areas along the Pacific Coast and Sierran foothills; in the same areas *Ganoderma brownii* commonly occurs on *Umbellularia*. Coastal and montane coniferous forests provide the habitat for *F. pinicola*, *F. pini*, *P. amarus*, *P. volvatus* and other fungi on gymnosperms. *P. vulpinus* occurs from very

low elevations to high montane regions, but it is usually found in relatively dry situations in association with *Populus*; in contrast, its closest relative, *P. dryophilus*, occurs on *Quercus* in more mesic situations. The two most characteristic fungi encountered in the low arid parts of California and Arizona are *P. munzii* and *T. hispida*, which occur on *Populus Fremontii* and *Salix* spp. Further generalizations cannot be made because of lack of records, and those above must certainly be considered tentative.

### HOST RANGES OF THE MOTHS

Almost without exception, the fungus species are more widespread than the insects that feed in them. Many of the hosts are Holarctic or even cosmopolitan in distribution and occur on a wide variety of tree species. The distributions of the moths are not determined by those of their hosts, since the Lepidoptera in most cases are neither limited to a single species of fungus nor as widespread as the fungi on which they occur. Thus both host selection and geographical distribution appear to be related to ecological factors other than food.

Among the 18 species of Lepidoptera encountered during this study, those which were reared at four or more localities provide the data for the assessment of host preference in the following discussion. Information available in the literature and on most older specimens is of little use in developing generalizations concerning host specificity. Either no specific fungus determination has been given or the moth identification can be considered suspect owing to the premature state of taxonomy at the time.

In our investigation we have considered some fungi as "incidental hosts" because the sporophores are seasonal and either decay relatively quickly or harden severely. It seems likely that the fruiting bodies of some fungi are not adequate to support populations of the moths on a continuous basis over a period of years. It is assumed

that polypores with large, perennial sporophores or with typically aggregated smaller ones, connected by exposed sterile tissue, provide necessary population reservoirs from which individuals move out to establish colonies in less permanent substrates. *Hypoxylon thouarsianum*, for example, has produced moths in about 25 per cent of our collections of it. In each case, however, only one or a few adult Lepidoptera emerged, and the fungus was found growing in association with sporophores of another species occupied by tineids in greater numbers. This suggests that the small and isolated fruiting bodies of *Hypoxylon*, which become relatively hard during the dry season, cannot support permanent populations of tineid moths in the ecological situations we have observed. A comparable situation probably exists with many Thelephoraceae and Polyporaceae as well, either because the fruiting bodies are not persistent (*Polyporus sulphureus*) or because they usually offer only sparse larval habitats (*Polyporus versicolor*, *Stereum hirsutum*). Rearing records from these "incidental hosts" may mask generalizations about host range or host specificity.

It is likely that many insects normally occurring on fungi may under given conditions feed on a variety of other substances. Thus, the European *Nemapogon granellus* has been recorded feeding in various stored food products, such as grain, meal, and dried mushrooms, as well as on Polyporaceae in nature (Schutze, 1931; Hinton, 1956). The ciid beetle, *Cis bidentatus* (Olivier), has been reared on stale bread and orange rinds in the laboratory (Fletcher, 1895), although it normally feeds on *Polyporus betulinus* and certain other fungi (Paviour-Smith, 1960). Similarly, it may be expected that in the field, substrates other than the principal host fungus will occasionally serve as food material. In one such case, the sporophore of a wood-rotting agaric, *Armillaria mellea*, was found to harbor a colony of *Nemapogon defectellus*. This moth had been reared from *Trametes*



*hispidula* at the same site on a previous occasion. It is assumed that the ephemeral nature of the *Armillaria* fruiting body eliminates any possibility of a moth population depending entirely upon this host. The same is probably true of other wood-rotting Agaricaceae, such as *Pleurotus ostreatus*, which we sampled several times without finding any evidence of Lepidoptera activity.

Criteria developed by Lawrence (1967) to evaluate possible incidental host records for Ciidae are not easily applicable to Microlepidoptera. In that study the presence of 10 or more adults or one or more immatures was taken as evidence of a breeding colony. Collections involving only a few adults were considered incidental. Using this method, *Ceracis thoracicornis* (Ziegler), for example, was found to have breeding records for only 14 of the 30 species of fungi from which it had been taken. During the present investigation the numerical density of larvae was not assessed. Adults reared indicate the presence of larvae or pupae at the time of collection, but in negative samples the possible presence of young larvae that were unable to complete their development under the rearing conditions cannot be ruled out. The actual number of individuals reared is not a consistent index of larval density owing to differences in the size of fruiting bodies, sample size, maturity of larvae at the time of collection, and the treatment of the sample after collection. Thus for the moths, consistent low numbers of individuals reared can be used only as supplementary evidence that a particular host is incidental.

*Oecophoridae*. In the Oecophoridae few rearings have been conducted under careful surveillance enabling recognition of the feeding substrate of even mature larvae. Nothing is known about the oviposition behavior or the feeding sites of young larvae. In general, it appears that fungus-feeding oecophorids and *Oinophila* have broader feeding ranges than fungus-feeding tineids. Some may be scavengers in abandoned

insect galleries, possibly only or mainly when the debris is moldy, and the use of wood-rotting fungi as a larval habitat may be incidental. This is true for *Endrosis sarcitrella*, probably is true for *Borkhausenia fuscescens*, and may be for *B. coloradella*. The last species will feed in bark, at least in diseased spots and during the construction of pupation galleries. *Borkhausenia quadrimaculella* may have similar habits but apparently is limited to coniferous tree associations.

The four records available for *Eumeyrickia trimaculella* have involved sporophores of Polyporaceae, and this species may be found to be limited to these hosts, possibly with narrow ecological restrictions limiting the range of species used, as in the case of some tineids.

*Tineidae*. The Tineidae considered here, by contrast, are strictly fungus feeders in the larval stage and are associated primarily with polypores.

A discussion of host ranges in North American tineids must be prefaced by a mention of the premature state of the taxonomy of this group at the present time. For the Palaearctic region, Hinton (1955, 1956), Petersen (1957, 1958), and Zagulajev (1959, 1960, 1964) have provided a sound basis for systematic work in the Tineidae. The concepts used by these workers, however, have not previously been applied to American members of the family, and the arrangement of genera in present checklists is more or less superficial, dating back to the work of Dietz, shortly after the turn of the century.

Thus the genus *Tinea*, as listed by McDunnough (1939), included a diverse assemblage of members of two or three subfamilies of Old World authors. Both animal and plant product feeders are represented, including most of the Nearctic species that are congeneric with the European *Nemapogon*, the largest Holarctic group of fungus-feeders. A few species representing other nemapogonine genera were encountered during this study, but their generic



assignments in our treatment should be considered tentative.

A series of species treated in the American literature under the genus name *Scardia* were also reared in the course of our work. Although these are not congeneric with *Scardia polypori* of Europe, they are members of the Scardiinae. For the purposes of the present study, it seems best to leave them assigned to "*Scardia*" rather than propose a new genus for them.

At the species level there remain some unsolved problems relative to the moths treated below. These have been discussed elsewhere (Powell, 1968a). Type material of nearly all American species of Scardiinae and Nemapogoninae have been examined, but genital characters of most have not been studied. In addition, several of Chambers's species are based on specimens which may be no longer extant. The fact that most Nearctic members of both of these subfamilies were originally described from eastern states, while virtually all of our material is western, has also affected the recognition of species. As a result, two or three of the forms discussed below may eventually be found to represent undescribed species where an old name is here applied. In these cases, however, previously described, related species have no known fungus associations, so that our speculations on host ranges should not be affected by subsequent changes in nomenclature. Preparations and comparisons of genitalia have been made for representatives of all series reared; thus, conclusions on species limits within our material are accurate, even if changes in the interpretation of names are applied later.

Table 1 summarizes host association information given below in the "biological data" for 13 species of Tineidae. Numbers without parentheses represent records which we consider "verified," whether one or many moths were reared. Verified records include all our own collections (those designated with JFL or JAP lot numbers in the data), a few collections

made by contemporary workers where host determinations can be considered accurate, and those from museum collections where identifiable samples of the host fungus were preserved with the moths. Numbers in parentheses represent records from the literature or from specimens that are not verified as to host identification.

An "index of productiveness" is given for each fungus species of which more than four collections were made. This represents the ratio of the number of verified records for a particular fungus to the total number of collections made of that fungus. Since more than one species of tineid may be reared from a single lot, a value greater than 1.0 is theoretically possible. A strong collecting bias was shown, especially during the early part of the study, for *Polyporus versicolor* and certain other fungi that have a greater number of ciid beetles associated with them. These collections were purposely not kept damp, and woody substrate subtending the sporophores usually was not taken. By contrast, species such as *Polyporus gilvus*, which are not productive for Ciidae in California, were not emphasized early in the study. Subsequently, they have proved to be principal hosts of tineids, and the collecting of them has increased, with more emphasis being placed on proper rearing methods for moths. Thus index values given in the table may not be entirely comparable between species, but they should serve to indicate the more consistently used fungus types. It can be seen from these index values that certain fungi, especially the related *Polyporus gilvus* (0.75) and *P. munzii* (0.57), are more frequently inhabited by tineids than are others (e.g., *Stereum hirsutum*, 0.09; *Fomes pinicola*, 0.05; or *Polyporus versicolor*, 0.03).

Among species with indices higher than the overall average of 0.19, *Hypoxylon thouarsianum* (0.25) and *Polyporus sulphureus* (0.33) have been discussed above and classified as "incidental hosts." In the case of the former, the high index is prob-

ably due to the frequent occurrence of this species in close association with *Polyporus gilvus* on dead *Quercus agrifolia*. *Polyporus sulphureus*, on the other hand, sometimes harbors large colonies of *Nemapogon*, and in ecological situations where sporophores are more persistent this species may constitute a principal host.

*Polyporus volvatus* (0.19) constitutes a special case, since it is the principal host of *Morophaga cryptophori* but probably serves as an incidental host for other tineids. Excluding records for *M. cryptophori*, *P. volvatus* has an index of only 0.04.

The Tineidae appear to comprise two groups with reference to their host ranges: a) host specific species, and b) ecologically restricted species, which utilize various wood-rotting fungi as they become available in the habitat. We found no species with both broad host acceptance and wide ecological tolerance, so that it occurred together with several other species. Five species of *Nemapogon* were represented in the more than 90 productive collections listed in our data, but in no case did more than two species of *Nemapogon* share the same host species in sympatry. Among the 13 species of Tineidae reared, no single collection included more than two species, although all four moths using *P. versicolor* were taken in central California Coastal Transition Zone localities and certainly could occur together. The highest number of moth species recorded for a single fungus was four (*P. sulphureus* and *H. thouarsianum*, in addition to *P. versicolor*). It is interesting that all three of these are considered to be incidental for at least two of the tineids involved.

*Host specific species.* The best example of apparent host specificity is that of *Morophaga cryptophori*, which has been reared at nine widely scattered California localities from *Polyporus volvatus* and was originally described from that fungus in Idaho. Most of our collections yielded only one or two adults each, but the small size

of *P. volvatus* sporophores may be a causal factor in the low numerical density of larvae. About 15 per cent of our collections of *P. volvatus* were productive for this moth, while all of the other fungi, such as *Fomes pinicola*, occurring in the same conifer associations were negative for it.

A second possible host specific species is *Nemapogon oregonellus*. On three separate occasions this species has been reared from *Polyporus amarus*, a fungus which is specific to *Libocedrus decurrens*. A fourth record from *Fomes pini* on *Pseudotsuga* was a Hopkins' collection involving an appreciable series of reared adults. Presuming the identification is correct, *Fomes pini* might be an incidental or occasional host for this moth species.

*Ecologically limited species.* Most of the Tineidae encountered during this study fall into this category. A spectrum from narrow to rather broad ecological tolerance is shown, but no species is so catholic in occurrence that it can be expected in any wood-rotting fungus in both boreal and austral areas, for example, throughout California.

The best examples of ecological isolation are those of our two most commonly sampled species, *Nemapogon molybdanellus* and *N. defectellus*. The latter is an austral species. Two of our collections of it were made in Transition Zone localities, while 10 of the collections are from Upper Sonoran situations. The species occurs in fungi on *Salix* or *Populus* growing along stream beds in arid or semi-arid regions. *Nemapogon molybdanellus*, by contrast, has been reared at 19 localities ranging from Coastal Transition Zone to the Canadian Zone at 6000 feet in the Sierra Nevada. Although 16 fungus species are recorded for these two *Nemapogon*, *Polyporus sulphureus* is the only host common to both, and this fungus is probably an incidental food plant in both cases. These two moths could occur together at a dry Transition Zone site, such as the oak woodland of the Inner Coast Range in California. Both

have been collected at Mt. Diablo, Contra Costa County, in similar situations, but the two have not been found coinhabiting the same fungus. "*Scardia*" *gracilis* seems to have a range similar to that of *N. molybdanellus*, but no generalizations can be made about the remaining species treated below due to the paucity of rearing records.

On the basis of the data presented here, it appears that the majority of fungus-feeding Tineidae, at least in western North America, are polyphagous, and that only one, *Morphaga cryptophori*, is host specific. It also appears that *Polyporus gilvus* and certain related brownish fungi, such as *P. munzii*, are frequently inhabited by Tineidae, and that *P. versicolor* and its relatives are not common hosts of these moths. This may be contrasted with the situation in the beetle family Ciidae. Paviour-Smith (1960) and Lawrence (1967) have shown that ciids often prefer a certain group of related fungi, such as the *Polyporus versicolor* group (*Coriolus*) or the *P. gilvus* group (*Phellinus*). Almost every species of tineid encountered in this study was reared from fungi belonging to both groups. Moreover, *P. gilvus* and other brownish fungi, in western North America, are rarely inhabited by Ciidae, while *P. versicolor* is a common host and may harbor up to seven species in central California.

## TINEIDAE

### NEMAPOGONINAE

#### *Nemapogon granellus* (Linnaeus)

*Tinea granella* Linnaeus, 1758, Syst. Nat., ed. 10, 1: 573.

*Nemapogon granellus*; Petersen, 1957, Beitr. Ent., 7: 68.

This species has become adapted to a wide variety of habitats associated with man's activities, in addition to occurring on a variety of Polyporaceae. Known as a grain moth to Linnaeus, *N. granellus* has been transported with commerce to many parts of the world, and it has been recorded from such diverse situations as dried mush-

rooms, cork, dried fruit, and plant bulbs (Hinton, 1956).

*Nemapogon granellus* probably has been established on the west coast of North America for a century or more, but its occurrence there has not been documented. Our collections suggest that the species has become established in a diverse array of natural habitats in the coastal parts of California. We have not encountered the species at higher elevations in the state.

*Biological data.*—CALIFORNIA: ALAMEDA CO.: Berkeley, VIII-1-27, 3 ♂♂ ex mushrooms in storage (E. C. Van Dyke); same locality, V-20-51, 2 ♂♂ ex mummified peach (W. W. Middlekauff); same locality, VII-19-60, 1 ♀ r.f. *Ganoderma brownii* on *Acacia* (J. F. Lawrence, JFL 645); U. C. Campus, Berkeley, VII-30-65, 2 ♂♂, 1 ♀ r.f. *Polyporus hirsutus* on *Quercus agrifolia*, emgd. VIII-12-65 (J. Powell, JAP 65G4); Berkeley Hills nr. Claremont Cyn., II-10-67, 1 ♂, 1 ♀ r.f. *Hypoxyton occidentale* [= *H. thouarsianum*] on *Quercus agrifolia*, emgd. II-28, III-31-67 (J. Powell, JAP 67B4); same locality, II-14-67, 3 ♂♂, 1 ♀ r.f. *Quercus agrifolia* bark and log with *Hypoxyton occidentale*, emgd. III-3 to IV-9-67 (J. Powell and P. A. Rude, JAP 67B6, B7); same locality, V-2-67, 3 ♂♂, 1 ♀, flying 6:00 PM assoc. with fallen *Quercus agrifolia* and *Hypoxyton occidentale* (J. Powell); Piedmont, XII-66, 1 ♂ r.f. oleander branch with black scale, emgd. II-13-67 (K. S. Hagen). MARIN CO.: Mill Valley, IX-18-56, 1 ♂ r.f. *Lithocarpus densiflorus* log (H. B. Lecch); Alpine Lake, I-19-67, 1 ♀ r.f. *Polyporus gilvus*, emgd. II-27-67 (P. A. Rude, JAP 67A10). MONTEREY CO.: Carmel, V-15-60, 1 ♂, 2 ♀♀ r.f. *Polyporus circinatus* on *Pinus radiata*, emgd. VI-10-60 (J. F. Lawrence, JFL 571). RIVERSIDE CO.: Riverside, III-4-61, ♂♂♀♀ r.f. *Polyporus sulphureus* on *Eucalyptus*, emgd. III-24-61 (P. H. Timberlake). SAN MATEO CO.: 1 mi. E La Honda, III-31-61, 1 ♀ r.f. *Polyporus gilvus* on *Umbellularia californica*, emgd. IV-10-61 (W. Azevedo, JFL 784); Menlo Park, XI-5-59, 1 ♂, 2 ♀♀ r.f. *Polyporus sulphureus*



(C. Duncan). SANTA BARBARA CO.: Prisoner's Harbor Creek, Santa Cruz Island, V-1-66, ♂ ♂ ♀ ♀ r.f. *Polyporus gilvus* on *Quercus agrifolia*, emgd. VI-15 to VIII-26-66 (J. Powell and J. Wolf, JAP 66E3).

***Nemapogon molybdanellus* (Dietz)**

*Tinea molybdanella* Dietz, 1905, Trans. Amer. Ent. Soc., 31: 61.

*Nemapogon molybdanellus*; Powell, 1968, Pan-Pac. Ent., 43: 293.

This species, which was originally described from Pasadena, California, has been the most commonly encountered fungus moth in our survey. It is geographically and ecologically widespread in California, having been collected from sea level up to 6000 feet in the Sierra Nevada. We have reared *N. molybdanellus* from about a dozen species of Polyporaceae and Xylariaceae.

**Biological data.**—**CALIFORNIA:** ALAMEDA CO.: Berkeley, V-29-60, 1 ♂, 1 ♀ r.f. *Poria versipora* on *Umbellularia californica*, emgd. VI-16-60 (J. F. Lawrence, JFL 581); Oakland, 1 ♂ r.f. *Polyporus ?versicolor*, emgd. IV-15-60 (no further data); Oakland Hills (Redwood Rd.), II-9-66, 3 ♂ ♂, 2 ♀ ♀ r.f. *Hypoxylon occidentale* [= *H. thouarsianum*] on *Quercus agrifolia*, emgd. II-29 to V-11-66 (J. Wolf, JAP 66B9); same data, 1 ♂ r.f. *Polyporus versicolor* on *Quercus agrifolia*, emgd. IV-15-66 (J. Wolf, JAP 66B11). CONTRA COSTA CO.: Tilden Park, Berkeley Hills, IX-10-62, 1 ♂ r.f. *Polyporus adustus* (P. deBenedictis, JFL 1102); same locality, II-4-66, 2 ♀ ♀ r.f. *Fomes ignarius* on *Quercus agrifolia*, emgd. IV-1 to IV-15-66 (A. J. Slater and J. Wolf, JAP 66B16); Russell Property, 4 mi. NE Orinda, XII-31-66, ♂ ♂ ♀ ♀ r.f. *Ganoderma ?brownii* on *Quercus agrifolia*, emgd. I-26 to III-22-67, IV-3 to IV-20-67, V-1-67 (J. Powell, JAP 67A5); 6 mi. S Clayton, I-22-61, 2 ♂ ♂, 2 ♀ ♀ r.f. *Polyporus sulphureus* on *Quercus agrifolia*, emgd. II-3 to II-27-61 (J. F. Lawrence, JFL 748). MARIN CO.: Alpine Lake, VII-7-66, 3 ♂ ♂, 2 ♀ ♀ r.f. *Polyporus gilvus* on *?Lithocarpus*, emgd. VIII-18 to

IX-22-66 (P. A. Rude and J. Wolf, JAP 66G4); 1 mi. S Inverness, III-17-66, 1 ♂ r.f. *Polyporus gilvus* on *Quercus agrifolia*, emgd. V-16-66 (J. Wolf, JAP 66C16); same data, 1 ♀ r.f. *Ganoderma applanatum* on *Umbellularia californica*, emgd. V-24-66 (J. Wolf, JAP 66C18). MONTEREY CO.: Big Sur, IV-16-61, 1 ♀ r.f. *Polyporus gilvus* on *Umbellularia californica* (J. F. Lawrence, JFL 795). SANTA BARBARA CO.: 6 mi. SE Lompoc, VII-9-65, ♂ ♂ ♀ ♀ r.f. *Polyporus gilvus* on *Quercus agrifolia*, emgd. VIII-10 to VIII-30-65 (J. Powell, JAP 65G3); same locality, I-17-66, ♂ ♂ ♀ ♀ r.f. *Polyporus gilvus* on *Quercus agrifolia*, emgd. II-11 to III-22-66 (J. Powell, JAP 66A17, A18); same data, 1 ♂ r.f. *Hypoxylon occidentale* on *Quercus agrifolia*, emgd. II-17-66 (J. Powell, JAP 66A22); same locality, IV-23-66, 1 ♂, 1 ♀ r.f. *Polyporus gilvus* on *Quercus agrifolia*, emgd. IV-24-66 (J. Powell, JAP 66D24); Prisoner's Harbor Creek, Santa Cruz Island, V-1-66, 5 ♂ ♂, 5 ♀ ♀ r.f. *Polyporus gilvus* on *Quercus agrifolia*, emgd. VI-15 to VIII-26-66 (J. Powell and J. Wolf, JAP 66E3); same data, 2 ♀ ♀ r.f. *Hypoxylon occidentale* on *Quercus agrifolia*, emgd. VII-13-66 (J. Wolf, JAP 66E5); Prisoner's Harbor, Santa Cruz Is., V-1-66, 1 ♂ r.f. *Hypoxylon occidentale* on *Quercus agrifolia*, emgd. VII-13-66 (J. Powell, A. J. Slater, J. Wolf, JAP 66E4); same data, 4 ♂ ♂, 2 ♀ ♀ r.f. *Polyporus gilvus* on *Quercus agrifolia*, emgd. V-5-66, VI-16 to VII-26-66 (J. Powell, A. J. Slater, J. Wolf, JAP 66E8). SONOMA CO.: 2.5 mi. S Cazadero, II-25-66, ♂ ♂ ♀ ♀ r.f. *Polyporus gilvus* on *Alnus*, emgd. III-25 to V-11-66, VIII-26, IX-9-66 (A. J. Slater and J. Wolf, JAP 66B41); Mark West Creek, 12 mi. NW St. Helena, II-18-66, 1 ♂, 2 ♀ ♀ r.f. *Polyporus adustus* on *Alnus*, emgd. III-25 to V-6-66 (A. J. Slater and J. Wolf, JAP 66B28); 2 mi. NW Cloverdale, VII-2-66, 1 ♂ r.f. *Polyporus colvatus* on *Pinus*, emgd. VII-26-66 (P. A. Rude, JAP 66G1). TEHAMA CO.: 9 mi. N Mineral, V-20-66, ♂ ♂ ♀ ♀ r.f. *Fomes officinalis* on *Abies magnifica*, emgd. VI-8 to IX-22-66 (J. Powell, A. J. Slater, J. Wolf, JAP 66E19).



TUOLUMNE CO.: Crane Flat, VI-16-61, 1 ♀ r.f. *Fomes pinicola* on *Abies concolor* (J. F. Lawrence, JFL 832); Dardanelle, VI-13-62, 2 ♂ ♂, 1 ♀ r.f. *Fomes pinicola* on *Abies* (J. F. Lawrence, JFL 1009).

***Nemapogon apicisignatellus* (Dietz)**

*Tinea apicisignatella* Dietz, 1905, Trans. Amer. Ent. Soc., 31: 65.

*Nemapogon apicisignatellus*; Powell, 1968, Pan-Pac. Ent., 43: 295.

The three collections of this species made during our study are from Polyporaceae occurring in similar Transition Zone situations. However, the species was originally described from Pennsylvania, and if our identification is correct (Powell, 1968a), *N. apicisignatellus* probably occupies more diverse habitats in other parts of its range.

The Canadian National Collection has specimens which appear to be this species, reared from *Ganoderma applanatum*, from Bell's Corners, Ontario, V-30-59 (E. C. Becker).

**Biological data.**—OREGON: DOUGLAS CO.: 10 mi. SW Camas Valley, X-24-62, ♂ ♂ ♀ ♀ r.f. *Polyporus adustus* on *Alnus*, emgd. XI-19-28-62 (J. F. Lawrence, JFL 1126). LANE CO.: Eugene, XII-25-61, ♂ ♂ ♀ ♀ r.f. *Polyporus dryophilus* on *Quercus*, emgd. I-27 to II-2-62 (D. H. Janzen, JFL 986). CALIFORNIA: SANTA CRUZ CO.: 5 mi. N Felton, V-29-66, ♂ ♂ ♀ ♀ r.f. *Polyporus adustus* on *Quercus agrifolia*, emgd. VII-6 to IX-22-66 (A. J. Slater, JAP 66E26).

***Nemapogon oregonellus* (Busck)**

*Tinea oregonella* Busck, 1900, Jour. N. Y. Ent. Soc., 8: 246.

*Nemapogon oregonellus*; Powell, 1968, Pan-Pac. Ent., 43: 295.

The four records available for *N. oregonellus* are of fungi associated with Douglas fir and incense cedar. Essig (1926) reported that this species breeds in woody *Polyporus* "on redwood and other coniferous trees."

**Biological data.**—OREGON: County unknown, nr. Parker's Station, XI-17-1914,

♂ ♂ ♀ ♀ r.f. *Trametes* [= *Fomes*] *pini* on *Pseudotsuga taxifolia* (P. D. Sergeant, Hopk. U. S. 13206a). CALIFORNIA: MADERA CO.: Yosemite Nat'l. Park, V-34, ♂ ♂ ♀ ♀ r.f. *Polyporus amarus* on *Libocedrus decurrens* [host preserved with moths] (W. H. Lange, Jr.). SAN FRANCISCO CO.: San Francisco, V-7-1914, ♂ ♂ ♀ ♀ r.f. sporophore *Polyporus amarus* on *Libocedrus decurrens* (T. D. Woodbury, Hopk. U. S. 12176). TEHAMA CO.: Round Valley, IX-1-61, 5 ♂ ♂ r.f. *Polyporus amarus* on *L. decurrens* (H. B. Leech, JFL 952).

***Nemapogon defectellus* (Zeller)**

*Tinea defectella* Zeller, 1873, Verhandl. Zool.-Bot. Ges. Wien, 23: 220.

*Nemapogon defectellus*; Powell, 1968, Pan-Pac. Ent., 43: 295.

This species was first described from San Francisco, California, and is now known to be widespread in semi-arid regions of the Southwest. Our records generally corroborate information available in the literature concerning its biology. Essig (1926) reported that *N. defectellus* breeds in woody *Polyporus* growing on cottonwood trees in New Mexico, Arizona, and California; and Linsley and Usinger (1936) encountered larvae in *Polyporus rheades* [= *P. dryophilus*] at Mt. Diablo in central coastal California. Bailey (1935) attributed the scarcity of sporophores of *P. rheades* at Mt. Diablo to the effects of insects, especially *N. defectellus*. Bailey mentioned that the larvae of this species persist even after the sporophores are extremely dry.

This is the only species of *Nemapogon* which has produced an appreciable number of individuals of a second generation from dry fungus material in the laboratory during our study. Whereas other species appear to be severely affected by drying of the substrate, and emergence of adults normally takes place only during the first few days or weeks, *N. defectellus* has continued to emerge over a four to eight month period in at least three of our collections. This represents at least one sub-

sequent generation resulting from the original emerging adults. Evidently the species has become adapted to living in arid regions in fungus substrates that are intermittently dry and available only in a desiccated condition.

*N. defectellus* is the most austral of the *Nemapogon* species encountered during our investigation, occurring in Transition and both Upper and Lower Sonoran Zone stations. The species seems to be especially adapted to riparian situations in arid areas, occurring on Polyporaceae associated with *Salix* and *Populus*.

**Biological data.**—OREGON: County unknown, Mistletoe, III-27-1915, ♂ ♂ ♀ ♀ r.f. "fungus fruiting body on black oak" (J. M. Miller and P. D. Sargent, Hopk. U. S. 12194). CALIFORNIA: CONTRA COSTA CO.: Mt. Diablo, I-23-34, ♂ ♂ ♀ ♀ r.f. *Polyporus rheades* [= *P. dryophilus*] (H. Bailey). RIVERSIDE CO.: Riverside, III-4-61, ♂ ♂ ♀ ♀ r.f. *Polyporus sulphureus* on *Eucalyptus*, emgd. III-24-61 (P. H. Timberlake); 4 mi. E Blythe, I-26-64, 2 ♂ ♂ r.f. *Trametes hispida* on *Populus fremontii*, emgd. II-26-64 (J. F. Lawrence, JFL 1255). SAN DIEGO CO.: Mission Dam, I-16-66, ♂ ♂ ♀ ♀ r.f. *Trametes hispida* on *Salix*, emgd. II-8 to III-18-66 (J. Powell, JAP 66A12, A13); same locality, VI-24-66, ♂ ♂ ♀ ♀ r.f. *Armillaria mellea* sporophore on *Salix*, emgd. VI-25-30-66, ♂ ♂ ♀ ♀ emgd. VIII-23 to X-27-66, 1 ♂ emgd. XII-5-66 (J. Powell, JAP 66F12), same data, 2 ♂ ♂, 1 ♀ r.f. *Trametes?* on *Salix*, emgd. VII-20, 29, IX-9-66 (J. Powell, JAP 66F11). ARIZONA: MARICOPA CO.: 5 mi. SE Wickenburg, I-26-64, ♂ ♂ ♀ ♀ r.f. *Polyporus munzii* on *Salix*, emgd. II-26 to VII-64 (J. F. Lawrence, JFL 1257). PIMA CO.: Sabino Cyn., Santa Catalina Mts., I-27-64, 3 ♂ ♂, 1 ♀ r.f. *Polyporus munzii* on *Salix* (J. F. Lawrence, JFL 1260). SANTA CRUZ CO.: Patagonia, VIII-10-61, 1 ♂ r.f. *Polyporus munzii* on *Populus fremontii* (J. F. Lawrence, JFL 930); 4 mi. NE Patagonia, I-29-64, ♂ ♂ ♀ ♀ r.f. *Polyporus vulpinus* on *P. fremontii*, emgd. V-VI-64 (J. F. Lawrence, JFL 1280);

2 mi. SW Patagonia, XI-14-64, ♂ ♂ ♀ ♀ r.f. *Polyporus munzii* on *Populus*, emgd. I-5 to V-3-65 (C. W. O'Brien, JAP 65A1). NEW MEXICO: CATRON CO.: 9 mi. S Luna, VII-31-61, ♂ ♂ ♀ ♀ r.f. *Polyporus dryophilus* on *Quercus* (J. F. Lawrence, JFL 874). TEXAS: BROWN CO.: Brownwood, XI-1-1919, ♂ ♂ ♀ ♀ r.f. "bracket fungus on mesquite" (no further data).

### *Homosetia maculatella* Dietz

*Homosetia maculatella* Dietz, 1905, Trans. Amer. Ent. Soc., 31: 84; Powell, 1968, Pan-Pac. Ent., 43: 297.

As indicated elsewhere (Powell, 1968a), the status of this species is uncertain because a cotype of *H. maculatella* from Placer County, California, may not be conspecific with the worn type from Pennsylvania. Moreover, since the California moth lacks conspicuous upraised scale rows of the forewing, it may not be congeneric with other members of *Homosetia*.

Populations here referred to *H. maculatella* occupy an extremely diverse ecological range, from Upper Sonoran Zone in the Central Valley to timberline at 10,000 feet in the central Sierra Nevada. Apparently a wide range of fungus substrates is used, probably even moldy debris associated with decaying wood.

**Biological data.**—CALIFORNIA: ALAMEDA CO.: Hayward, X-28-54, 2 ♂ ♂, 2 ♀ ♀ "from fungi on damp and decaying wood" (E. G. Linsley). CONTRA COSTA CO.: 6 mi. SE Clayton, I-22-61, 5 ♂ ♂, 3 ♀ ♀ r.f. *Polyporus sulphureus* on *Quercus agrifolia*, emgd. II-17-21-61 (J. F. Lawrence, JFL 748). EL DORADO CO.: Blodgett Forest nr. Georgetown, VI-28-65, 1 ♂ r.f. 2 year old *Pinus jeffreyi* logs with moldy weevil galleries (I. Otvos and J. H. Borden, JAP 65H3). MONO CO.: Saddlebag Lake, 10,500 ft., VII-7-62, 1 ♂ r.f. *Serpula americana* [= *Merulius americanus*] on *Pinus murrayana* (J. F. Lawrence, JFL 1051). MONTEREY CO.: Carmel, V-15-60, 1 ♂ r.f. *Polyporus circinatus* on *Pinus radiata* (J. F. Lawrence, JFL 571). SACRA-

MENTO CO.: Sacramento, I-10-31, ♂♂ r.f. "*Poria* sp.", emgd. II-23 to III-5-31 (A. C. Browne, #3121).

## TINEINAE

### *Monopis mycetophilella* Powell

*Monopis mycetophilella* Powell, 1968, Pan-Pac. Ent., 43: 298.

Although a general biological characteristic of members of the subfamily Tineinae and of *Monopis* is the use of animal products as larval food, this species evidently normally feeds in fungus and associated decaying wood. Our specimens were obtained from polypores with relatively little decaying wood substrate attached. According to Forbes (1923), the larva of a closely related species, *M. croceoverticella* (Chambers), is a case bearer which lives externally on the white bracket fungus on beech. A Palearctic species, *M. fenestratella* (Heyden), has been reared from decaying wood and old, crumbling *Daedalea quercina* (Polyporaceae) (Meyrick, 1895; Schutze, 1931).

The fungi from which we have reared *M. mycetophilella* are two of our more commonly sampled species, indicating that this moth probably is non-specific in host selection. Its scarcity may in part be due to a single generation, late flight period, similar to that of *Borkhausenia coloradella*. Most of our Pacific Coast fungus collections have been made during or shortly following the rainy season.

**Biological data.**—CALIFORNIA: ALAMEDA CO.: Oakland, VII-1-60, 1 ♂ r.f. *Polyporus versicolor* on *Quercus agrifolia*, emgd. VII-10-60 (M. Lundgren, JFL 635). CONTRA COSTA CO.: 2 mi. SE Canyon, II-5-67, 2 ♂♂ r.f. *Polyporus gilvus* on *Quercus agrifolia*, emgd. V-1, 11-67 (J. Powell, JAP 67B1).

## MEESSIINAE

### *Celestica* species

As discussed previously (Powell, 1968a), a single specimen was reared during our

survey that appears to be a species of this genus. Members of this subfamily feed on lichens, so far as is known, occurring on rock walls and in similar situations in Europe (Schutze, 1931). No species of the Nearctic fauna have as yet been referred to the series of genera treated as Meessiinae by Old World authors. However, some members of this group undoubtedly do occur in North America.

Our *Celestica* was reared from bark of *Quercus* with *Stereum* (Thelephoraceae), which was not noted to have any lichen, but may have included some.

**Biological data.**—CALIFORNIA: SANTA BARBARA CO.: Prisoner's Harbor, Santa Cruz Island, V-1-66, 1 ♂ r.f. *Stereum hirsutum* on *Quercus agrifolia*, emgd. V-27-66 (J. Powell and J. Wolf, JAP 66E6).

## SCARDIINAE

### *Morophaga cryptophori* Clarke

*Morophaga cryptophori* Clarke, 1940, Bull. So. Calif. Acad. Sci., 39: 114.

This species was described from material reared in Idaho from *Cryptophorus* [= *Polyporus*] *volvatus*. During the present study the species has been obtained from the same host, associated with *Abies* and *Pinus*, at several widely scattered stations in California.

It appears that *M. cryptophori* is a host specific feeder on *P. volvatus* and is widespread in montane areas of western North America. In Europe, *M. morella* (Duponchel), the only other member of the genus, feeds on fungus associated with nonconiferous plants, including mulberry and *Ephedra* (Dumont, 1930; Petersen, 1957c).

**Biological data.**—CALIFORNIA: EL DORADO CO.: N of Robb's Peak, 6000 ft., VII-1-67, 5 ♂♂ r.f. *Polyporus volvatus* on *Abies*, emgd. VII-26, 27, VIII-67 (J. Powell and R. Stultz, JAP 67G1, 3); Blodgett Forest, 13 mi. E Georgetown, VII-9-67, ♂♂♀♀ r.f. *P. volvatus*, emgd. VII-(23-27)-67 (W. J. Turner, JAP 67G5). GLENN CO.: Plaskett Meadows, VII-31-65, 1 ♀ r.f. *Polyporus volvatus*, emgd. VIII-27-65 (J. T. Doyen).



PLACER CO.: Squaw Valley, VIII-17-60, 1 ♂ r.f. *Polyporus volvatus* on *Pinus*, emgd. VIII-24-60 (P. deBenedictis, JFL 661). RIVERSIDE CO.: Idyllwild, VI-21-62, 1 ♀ r.f. *Polyporus volvatus* on *Pinus*, emgd. VII-10-62 (J. F. Lawrence, JFL 1022); Humber Park, 2 mi. NE Idyllwild, VI-21-62, 1 ♀ r.f. *Polyporus volvatus* on *Abies* (J. F. Lawrence, JFL 1025). SIERRA CO.: Yuba Pass, VII-7-66, 7 ♂ ♂, 3 ♀ ♀ r.f. *Polyporus ?volvatus* (W. J. Turner). TRINITY CO.: Scott Mtn. Summit, 5300 ft., 19 airline mi. N Trinity Center, VII-5-63, 1 ♀ r.f. *Polyporus volvatus* (C. D. MacNeill and V. Whitehead). TUOLUMNE CO.: Tuolumne Grove, VII-21-61, 1 ♀ r.f. *Polyporus volvatus* on *Abies concolor* (W. E. Ferguson, JFL 852).

#### *Diataga leptosceles* Walsingham

*Diataga leptosceles* Walsingham, 1914, Biol. Centrali-Amer., Lep. Het., 4: 375.

This species was described from Jalapa, Veracruz, Mexico, and it may be that not all of our material is conspecific. We have only two females representing a record for the species in Arizona and have not had typical material for comparison of other than external features.

The tentative identification and our fragmentary rearing information do not enable conclusions on host selection of the species. Specimens identified as *D. leptosceles* in the U. S. National Museum, collected in Trinidad, were reared from a species of "*Polyporus*."

**Biological data.**—ARIZONA: COCHISE CO.: 15 mi. E Douglas, VIII-5-61, 2 ♀ ♀ r.f. *Polyporus vulpinus* on *Populus fremontii* (J. F. Lawrence, JFL 908). MEXICO: VERACRUZ: Fortin de las Flores, XII-24-63, 2 ♀ ♀ r.f. *Daedalea microsticta* (C. A. Toschi and M. J. Tauber, JFL 1254).

#### *Scardia polypori* (Esper)

As discussed elsewhere (Powell, 1968a), most of the North American species currently assigned to *Scardia* probably are not congeneric with the European type of the

genus, *S. polypori*. Larval characteristics of one species indicate that they are Scardiinae, but the species reared during our investigation are not referable to any Palearctic genus. They are provisionally retained as "*Scardia*" until taxonomic assessment of the North American fauna is possible.

Several Polyporaceae have been reported as hosts of *S. polypori*: *Polyporus sulphurella* [= *P. sulphureus*] and dead wood attacked by fungi in England (Hinton, 1956), *Polyporus* [= *Fomes*] *fomentarius* in Germany (Mitterberger 1910, 1911), and *Trametes gibbosa* and *Polyporus adustus* in Switzerland (Rehfous, 1955b).

#### "*Scardia*" *coloradella* Dietz

*Scardia coloradella* Dietz, 1905, Trans. Amer. Ent. Soc., 31: 25.

"*Scardia*" *coloradella*; Powell, 1968, Pan-Pac. Ent., 43: 302.

The identity of the moths we are treating under this name has been discussed previously (Powell, 1968a). Host specificity is not shown by populations of "*S.*" *coloradella*, if colonies represented by our samples are conspecific. The general habitat is high elevation coniferous forests in each case.

**Biological data.**—COLORADO: EL PASO CO.: North Cheyenne Cyn., XII-11-1914, ♂ ♂ ♀ ♀ r.f. fungus at base of dead *Pseudotsuga taxifolia* (A. B. Champlain, Hopk. U. S. 12173b). ARIZONA: COCHISE CO.: Rustler Park, 8 mi. W Portal, Chiricahua Mts., VII-3-61, 1 ♀ r.f. *Polyporus anceps* on *Pinus* (J. F. Lawrence, JFL 889). UTAH: UTAH CO.: N of Mt. Timpanogos, 7300 ft., VII-30-67, 3 ♀ ♀ r.f. *Ganoderma applanatum* on *Populus tremuloides*, emgd. VIII-4 to X-67 (J. Powell, JAP 67G6). MEXICO: DURANGO: 10 mi. W El Salto, 9,000 ft., VII-23-64, 3 ♀ ♀ r.f. *Ganoderma lobatum* on *Quercus ommissa*, emgd. IX-8, 9-64 and later (J. Powell, JAP 64G10, JFL 1313).

#### "*Scardia*" *gracilis* Walsingham

*Scardia gracilis* Walsingham, 1907, Proc. U. S. Nat'l. Mus., 33: 225.



"*Scardia*" *gracilis*; Powell, 1968, Pan-Pac. Ent., 43: 302.

This species exhibits a great deal of variation in external appearance and size, in part related to the condition of the substrate in which the larvae have fed (Powell, 1968a). "*Scardia*" *gracilis* was the most common member of the subfamily encountered during our survey, limited primarily to Polyporaceae with relatively large and persistent sporophores, or large colonies with extensive sterile tissue in species with small sporophores. The larvae frequently live within the decaying wood subtending the sporophores, and at times the emergence galleries occur several centimeters from the sporophores.

"*Scardia*" *gracilis* apparently has the same ecological range and host acceptance as *Nemapogon molybdanellus*, but in California *gracilis* may be limited to the Coast Range. Fungus collections from the Sierra Nevada have yielded only a single specimen of "*Scardia*," that from Buck's Lake, Plumas County. Although its genitalia are not distinguishable from other *gracilis*, this individual may not be conspecific. It is paler with more reduced dark markings than any other "*Scardia*" reared, but it is in worn condition.

**Biological data.**—**CALIFORNIA:** GLENN CO.: Plaskett Meadows, 6,200 ft., VII-3-60, 1 ♀ as adult on *Fomes pinicola* on *Abies concolor* (J. Powell, JFL 631). MARIN CO.: Alpine Lake, III-30-66, ♂ ♂ ♀ ♀ r.f. *Polyporus gilvus* on old *Lithocarpus*?, emgd. IV-11 to V-17-66 (J. Powell, JAP 66C27); same data, VII-7-66, 1 ♂ emgd. IX-22-66 (P. A. Rude and J. Wolf, JAP 66G4); same data, 1 ♀ r.f. *Lenzites betulina* on *Umbellularia*, emgd. IX-16-66 (Rude and Wolf, JAP 66G5); same locality, I-19-67, 3 ♂ ♂, 3 ♀ ♀ r.f. *Polyporus gilvus*, emgd. II-27 to IV-3-67 (P. A. Rude, JAP 67A10); 1 mi. S Inverness, III-17-66, ♂ ♂ ♀ ♀ r.f. *Polyporus gilvus* on *Quercus agrifolia*, emgd. IV-4 to VI-15-66, 1 ♂ emgd. VIII-16-66 (J. Wolf, JAP 66C16); same data, 1 ♂ r.f. *Hypoxylon occidentale* [= *H. thouarsianum*] on *Umbellularia*,

emgd. III-22-66 (J. Wolf, JAP 66C17); same data, 3 ♂ ♂ r.f. *Polyporus versicolor* on *Quercus agrifolia*, emgd. IV-19 to V-11-66, 1 ♀ emgd. IX-16-66 (J. Wolf, JAP 66C18); same locality, VII-7-66, 1 ♀ r.f. *Stereum hirsutum* on *Umbellularia*, emgd. IX-16-66 (P. A. Rude and J. Wolf, JAP 66G8). PLUMAS CO.: Buck's Lake, VII-26-64, 1 ♂ r.f. *Polyporus sulphureus* (J. T. Doyen). SAN FRANCISCO CO.: Sutro Forest, San Francisco, II-20-1913, 1 ♂ r.f. *Polyporus volvatus* [host pinned with moth], emgd. IV-1-1913 (J. C. H. [uegenin]). SAN MATEO CO.: Lake Merced, III-26-1908, 1 ♂ r.f. rotten *Lupinus arboreus* stem (F. X. Williams); Mindego Creek Cyn., 1 mi. E La Honda, III-31-61, ♂ ♂ ♀ ♀ r.f. *Polyporus gilvus* on *Umbellularia*, emgd. IV-(6-19)-61 (W. Azevedo, JFL 784). SANTA CLARA CO.: 2 mi. SW Los Gatos, V-6-61, 1 ♂ r.f. *Polyporus gilvus*, emgd. V-30-61 (W. E. Ferguson, JFL 805). SANTA CRUZ CO.: 5 mi. N Felton, V-29-66, 4 ♀ ♀ r.f. *Polyporus adustus* on *Quercus agrifolia*, emgd. VIII-2-18-66 (A. J. Slater, JAP 66E26). SONOMA CO.: 1 mi. S Cazadero, II-24-63, 1 ♂, 3 ♀ ♀ r.f. *Polyporus versicolor* on *Umbellularia*, emgd. IV-14-28-63 (J. Powell, JAP 63B5, B6); 2.5 mi. S Cazadero, II-25-66, ♂ ♂ ♀ ♀ r.f. *Polyporus gilvus* on *Alnus*, emgd. III-28 to V-17-66, 2 ♂ ♂, 1 ♀ emgd. V-27 to VI-6-66, ♂ ♂ ♀ ♀ emgd. VIII-12 to IX-16-66 (A. J. Slater and J. Wolf, JAP 66B41).

#### "*Scardia*" *berkeleyella* Powell

"*Scardia*" *berkeleyella* Powell, 1968, Pan-Pac. Ent., 43: 303.

Although this moth, which is much smaller than other members of the genus, was discovered only recently, it appears to have a broad host range comparable to that of "*S.*" *gracilis*. Probably it feeds in Polyporaceae of appropriate size and in associated decaying wood, but has restricted colonies owing to other factors. All collections which have been productive for this species have been made early in the year, prior to the end of the rainy season.

*Biological data.*—**CALIFORNIA:** ALAMEDA CO.: Strawberry Cyn., Berkeley Hills, I-10-63, 1 ♂ r.f. *Polyporus versicolor* on old *Quercus agrifolia*, emgd. III-8-63 (J. Powell, JAP 63A8). CONTRA COSTA CO.: 2 mi. SE Canyon, II-5-67, 3 ♂ ♂, 2 ♀ ♀ r.f. *Polyporus gilvus* on *Q. agrifolia*, emgd. III-31 to IV-9-67 (J. Powell, JAP 67B1). MARIN CO.: Hilltops S of Marin City, III-25-57, 1 ♀ r.f. dead stems *Lupinus propinquus*, emgd. IV-25-57 (H. B. Leech); Mill Valley, II-12-64, 1 ♂ r.f. log *Lithocarpus densiflorus*, emgd. IV-16-64 (H. B. Leech).

## OECOPHORIDAE

### *Borkhausenia (Borkhausenia) fuscescens* (Haworth)

*Recurvaria fuscescens* Haworth, 1829, Lepid. Brit., 4: 555.

*Borkhausenia fuscescens*; Staudinger and Rebel, 1901, Cat. Lepid. Palaear., 2: 177.

As discussed elsewhere (Powell, 1964b), this Palearctic species has been introduced into urban areas of California, and European reports relating to its biology indicate that it is a scavenger. Most of the reports are old and are vague to the extent that the larval food is not given. The habits are equally poorly known in California. Armitage (1952) suggested that *B. fuscescens* may feed in "mouldy trash or leaves," and our isolated reared specimens may have been associated with galleries of other insects or with other debris in the fungus substrates.

*Biological data.*—**CALIFORNIA:** CONTRA COSTA CO.: Tilden Park, Berkeley Hills, IX-10-62, 1 ♀ r.f. *Polyporus adustus* (P. de Benedictis, JFL 1102); Tilden Park, II-14-66, 1 ♀ r.f. *Fomes ignarius* on *Quercus agrifolia*, emgd. III-25-66 (A. J. Slater and J. Wolf, JAP 66B16).

### *Borkhausenia (Decantha) boreasella* (Chambers)

*Oecophora boreasella* Chambers, 1873, Canad. Ent., 5: 189.

*Decantha boreasella*; Clarke, 1941, Proc. U. S. Natl. Mus., 90: 242 (synonymy).

This species is widespread over much of boreal North America and occurs in the mountains along the length of California. The record given below is the first we have seen from any locality which is other than a conifer association. Clarke (1941) stated there were no known host records. Larvae of the closely related *B. borkhauseni* (Zeller) live under loose bark of old pine trees in Europe (Schutze, 1931).

In our collection, a moth emerged from bulk material including sporophores of *Hypoxyton* on branch sections of oak, and the feeding site is unknown.

*Biological data.*—**CALIFORNIA:** SANTA BARBARA CO.: Santa Cruz Island, Prisoner's Harbor, V-1-66, 1 ♀ r.f. *Hypoxyton occidentale* [= *H. thouarsianum*] on *Quercus agrifolia*, emgd. VI-15-66 (J. Powell, A. Slater, J. Wolf, JAP 66E4).

### *Borkhausenia (Schiffermuelleria) quadrimaculella* (Chambers)

*Oecophora quadrimaculella* Chambers, 1877, Cincinnati Quart. Jour. Sci., 2: 292.

*Borkhausenia quadrimaculella*; Kearfott, 1903, in: Smith, Checklist Lepid. Bor. Amer.: 115.

*Epicallima quadrimaculella*; Busck, 1908, Proc. U. S. Natl. Mus., 35: 202.

*Schiffermuelleria quadrimaculella*; Meyrick, 1922, Gen. Insectorum, 180: 27; Clarke, 1941, Proc. U. S. Natl. Mus., 90: 248 (synonymy).

*Oecophora dimidiella* Walsingham, 1888, Insect Life, 1: 148.

This distinctive species, which has blackish forewings marked with yellow spots, is widespread in boreal and transition zone areas of western North America. It was reported from Alberta and British Columbia, southward to Colorado and southern California by Clarke (1941), and we have seen it from the Sierra San Pedro Martir in Baja California, some 200 miles south of the international border.

Records given by Clarke indicate an association with coniferous forest trees, and we have encountered the species on several occasions in similar situations. Most collections reveal only circumstantial evidence of a fungus feeding habit, but it appears that

conifer wood-rot fungi serve as a larval habitat at least part of the time. Clarke (1941) suggested that the larvae may feed on refuse that collects in cracks in the bark, and it may be that *S. quadrimaculella* is often a scavenger in association with decaying coniferous trees.

The adults are found under bark of fallen trees and occasionally on fungus sporophores. Our collection from Blodgett Forest, listed below, consisted of several logs which had been heavily scored by weevil larvae in the cambium area. Examination of the bark after emergence of numerous *Schiffermuelleria* revealed that lepidopterous webbing and frass was associated with a variety of sites, in external cracks in the bark, in beetle galleries under the bark, and in the thick bark itself. The only cocoons with oecophorid pupal shells and larval exuviae occurred in the bark, above the level of the mouldy weevil burrows, either in flat chambers which had evidently been excavated by the moth larvae, or in one instance in the abandoned emergence trackway of a beetle gallery.

**Biological data.**—CALIFORNIA: CALAVERAS CO.: Bailey Ridge, 16 mi. E West Point, V-26-64, 2 ♂♂ r.f. *Pinus ponderosa* with *Polyporus volvatus* (G. Lanier). EL DORADO CO.: Blodgett Forest nr. Georgetown, ♂♂♀♀ r.f. 2 year old *Pinus ponderosa* logs killed by weevils, emgd. VI-28-64 (I. Otvos, J. H. Borden, JAP 65H3). KERN CO.: 4 mi. N Alta Sierra, IV-28-64, 2 ♂♂, 1 ♀ r.f. [sporophores] *Polyporus volvatus*, emgd. V-22-64 (J. Doyen). NEVADA CO.: Boca, VI-17-64, 1 ♂ under bark fallen tree (D. F. Veirs). TULARE CO.: Portugese Pass, 7 mi. SE Pine Flat, VII-5-62, 1 ♀ as adult on *Fomes pinicola* (J. Lawrence, JFL 1097). VENTURA CO.: 10 mi. NW Lake of the Woods [Mt. Pinos, 6000 ft.] VI-7-64, 1 ♂, 1 ♀ under bark *Pinus* (W. J. Turner).

*Borkhausenia* (*Schiffermuelleria*) *coloradella* (Walsingham), New Combination

*Oecophora coloradella* Walsingham, 1888, Insect Life, 1: 150.

*Epicallima coloradella*; Busck, 1908, Proc. U. S. Natl. Mus., 35: 201.

*Ethmia coloradella*; Clarke, 1941, Proc. U. S. Natl. Mus., 90: 247.

This and the following species, *Eumeyrickia trimaculella*, were referred to the Ethmiidae by Clarke (1941), primarily on the basis of a "segmented" valva in the male genitalia. Although the Ethmiidae remains a somewhat heterogeneous assemblage, not well separated from the Oecophoridae, placement of *coloradella* and *trimaculella* with the oecophorids appears to be a more realistic indication of their relationships, particularly in view of the larval habits. *B. coloradella* feeds in fungus, in dead tissue associated with diseased areas on living trees, under bark of fallen trees, or possibly on debris in galleries of other insects in these habitats. Some members of *Schiffermuelleria* and other subgenera of *Borkhausenia* are known to feed in decaying wood or fungus under bark in the Old World (e.g., Meyrick, 1895; Schutze, 1931; Jacobs, 1950), while available information indicates that all *Ethmia* are external feeders on leaves or flowers.

On the basis of extensive revisionary work (in preparation) on the ethmiids of the Palearctic by Klaus Sattler and of the New World by Powell, structural characters of the adults of the two present species indicate that they should be placed back in the Oecophoridae. Whether the subgenus *Schiffermuelleria* is sufficiently diverse to accommodate *coloradella* may have to be answered by a re-examination of *Borkhausenia*, but characters of both male and female *coloradella* are unlike their homologues in *Ethmia*, *Pseudethmia*, and *Pyramidobela*. The divided valva does not appear to be comparable to that of *Ethmia*, while a division of this type does occur in certain *Borkhausenia* (i.e., *unitella* Hübner and *incongruella* Zeller). The heavily sclerotized, ventrally curved uncus and the elongate vinculum are features *coloradella* shares with members of various subgenera of *Borkhausenia* and with no



ethmiid. The strongly curved aedoeagus, perhaps the single most universal characteristic of male Ethmiidae, is not developed in *coloradella* or in oecophorids generally. The elongate, extensible ovipositor and correspondingly elongate apophyses are traits of female *coloradella* exhibiting similarity to those shown in *Schiffermuelleria* and *Fabiola*, but differing from their counterparts in Ethmiidae. Moreover, no ethmiid bears superficial resemblance to *coloradella*, but several oecophorids have similar facies in wing shape and color, broad hindwing fringe, elongate abdomen, etc. (e.g., *Esperia sulphurella* (F.), *Borkhausenia stipella* (L.), *B. quadrimaculella* (Chamb.)).

As mentioned by Yothers (1942), the cocoon of *B. coloradella* is extremely flimsy, as in related oecophorids such as *Esperia sulphurella*. Cocoons of *Ethmia*, even multivoltine species, are dense (Powell, 1968b). Finally, the highly characteristic "anal legs" of the pupa, a feature which is well developed in all *Ethmia* so far as is known, are not present on the pupa of *B. coloradella*. Its caudal structures are similar to those of *E. sulphurella* and *B. quadrimaculella*, both of which possess a single, stout, terminal rod which is directed posteriorly.

*Borkhausenia coloradella* is widespread in boreal parts of North America, from Ontario and New York to British Columbia and the northwestern United States, southward to northern Arizona and central California. Rearing records suggest a biology for *B. coloradella* similar to that of *B. (Schiffermuelleria) quadrimaculella*, discussed above. The present species often emerges from caged logs or in similar forestry practice situations and has been reared from fungus sporophores during our study. In addition, D. P. Pielou, of the Entomology Research Institute, Ottawa, has obtained a few *coloradella* from sporophores of *Polyporus* and *Fomes* collected from birch in southern Ontario in May after overwintering in the field (Pielou,

in litt., 1966; Pielou and Matthewman, 1966). The species has been reared on a number of occasions in connection with the Hopkins collections. The specific larval food in most of these cases is unknown, but in Montana (Hopk. 12 316), Brunner noted that the small, black larvae fed in fresh bark immediately under the layer of rough, old bark on *Pinus ponderosa*. Feeding resulted in a diseased looking area of the cambium, which, however, was not reached by feeding larvae. Some larvae were located in a spot where decay of the bark and cambium had begun. Larvae were also noted to be cannibalistic and predatory on larvae of *Pinipestis* [= *Dioryctria*], Pyralidae).

The most extensive study of the biology of *B. coloradella* is that of Yothers (1932, 1942), who found the larvae inside the closed, perennial cankers caused by the fungus *Neofabracea* on apple trees. Dead aphids (*Eriosoma*), honeydew, and excreta were massed together with the webbing of the moth larvae. He observed that larvae fed on dead and decaying wood and bark, particularly old, desiccated callus tissue, and did not feed on live callus tissue.

*Biological data.*—CANADA: ONTARIO: Bell's Corners, r.f. *Polyporus betulinus* on *Betula*, emgd. VI-10-65; r.f. *Fomes fomentarius* on *Betula*, emgd. VI-21-65 (D. P. Pielou). WASHINGTON: PEND OREILLE CO.: Metaline Falls, V-22-31, 2 ♂ ♂ r.f. *Pseudotsuga menziesii* bark (Hopk. 21 309) (W. D. Bedard). MONTANA: MISSOULA CO.: Missoula, II-20-14, 1 ♀ r.f. *Pinus ponderosa* bark, emgd. III-5-14 (Hopk. 12 316) (J. Brunner). IDAHO: VALLEY CO.: Kras-sel Rgr. Station, 1957, ♂ ♂ ♀ ♀ r.f. *Pseudotsuga menziesii* stems with *Dendroctonus* (Hopk. 35 025 m) (H. M. Furniss); same locality III-28-62, 2 ♀ ♀ r.f. *Alnus* stem infested with Cerambycidae (Hopk. 41 890p) (H. M. Furniss); same locality IX-6-62, 1 ♂ 1 ♀ r.f. *Pseudotsuga menziesii* stems with *Dendroctonus*, emgd. III-18-63 (H. M. Furniss). CALIFORNIA: ALAMEDA CO.: Berkeley, V-29-60, 1 ♂ r.f. *Poria versipora* on



*Umbellularia californica* (J. Lawrence, JFL 581); Berkeley Hills nr. Claremont Cyn., II-10-67, 1 ♀ r.f. *Quercus agrifolia* bark with *Stereum*, emgd. III-21-67 (J. Powell, JAP 67B5); same locality, II-14-67, 1 ♂, 3 ♀ r.f. *Quercus agrifolia* bark with *Stereum* and log with *Hypoxylon*, emgd. III-19 to IV-20-67 (J. Powell and P. A. Rude, JAP 67B6, B7); Oakland Hills (Redwood Road), II-9-66, 1 ♀ r.f. *Hypoxylon occidentale* [= *H. thourasianum*] on *Quercus agrifolia*, emgd. V-6-66 (J. Wolf, JAP 66B9). SONOMA CO.: 4 mi. NW Camp Meeker, II-25-66, 1 ♀ r.f. *Stereum hirsutum* on *Lithocarpus*, emgd. V-11-66 (A. J. Slater and J. Wolf, JAP 66B39).

#### *Eumeyrickia trimaculella* (Fitch)

*Chaetochilus trimaculellus* Fitch, 1856, Trans. N. Y. Agric. Soc., 15: 455. (Reprinted, 1856, as separately paged vol., Report on Noxious, Beneficial and other insects, N.Y., II, p. 233). *Eumeyrickia trimaculella*; Busck, 1902, Jour. N. Y. Ent. Soc., 10: 94 (synonymy); Clarke, 1941, Proc. U. S. Natl. Mus., 90: 271 (placed in Ethmiidae).

*Anarsia*? *albabulvella* Chambers, 1875, Canad. Ent., 7: 147.

*Chimbache*? *haustellata* Walsingham, 1882, Trans. Amer. Ent. Soc. Phila., 10: 173.

As mentioned in connection with the preceding species, assessment of structural characters of *E. trimaculella* in connection with current studies on the Ethmiidae indicate that this species should be referred to the Oecophoridae, in contrast to the opinion of Clarke (1941).

Details of the biology of this insect have not been reported, but it is a fungus feeder, at least at times, which lends credence to the supposed relationship with the Oecophoridae. Fitch (1856) found *trimaculella* in yards about houses and mentioned its oviposition habits but did not state upon what substrate the eggs were deposited. The moths were noted to favor hollow trees by Forbes (1923), but evidently no larval food was known then. Through the cooperation of D. P. Pielou, of the Entomology Research Institute, Ottawa, we have been able to examine specimens of

*E. trimaculella* which he has reared in connection with investigations on the insect community of *Polyporus betulinus* and *Fomes fomentarius* on birch (Pielou, 1966; Pielou and Matthewman, 1966). Sporophores which had overwintered in the field were collected in May and June.

**Biological data.**—CANADA: QUEBEC, Gati-neau Park, r.f. *Polyporus betulinus*, emgd. VI-10-65; r.f. *Fomes fomentarius*, emgd. VII-15, VIII-5-65 (D. Pielou). VERMONT: BENNINGTON CO.: East Dorset, VI-6-65, 1 ♂ r.f. undet. fungus (C. Parsons, JFL 1715); Green Peak, 2000 ft., East Dorset, VI-6-65, 1 ♀ r.f. *Fomes fomentarius* on *Betula lutea* (C. Parsons, JFL 1707).

#### OINOPHILIDAE

##### *Oinophila v-flava* (Haworth)

*Gracillaria v-flava* Haworth, 1811, Lepid. Britannica, 4: 530.

*Oinophila v-flava*; Stephens, 1848, Proc. Ent. Soc. London, 5(5): lxi.

As discussed elsewhere, this species is thought to have been introduced into California from Europe (Powell, 1964a). The habits are poorly known and *O. v-flava* may be a general scavenger, but it appears that feeding usually takes place on some fungus, such as on a moldy substrate.

**Biological data.**—CALIFORNIA: ALAMEDA CO.: Berkeley Hills nr. Claremont Cyn., II-14-67, 2 ♂ ♂, 2 ♀ ♀ r.f. bark *Quercus agrifolia* with *Stereum* and *Hypoxylon*, emgd. III-16 to IV-3-67 (J. Powell and P. A. Rude, JAP 67B6, B7). SANTA BARBARA CO.: Prisoner's Harbor, Santa Cruz Island, IV-29-66, 1 ♂ as adult on *Polyporus gilvus* on *Quercus agrifolia*, emgd. VIII-2, VIII-12-66 (J. Powell, A. Slater, J. Wolf, JAP 66E8). SANTA CLARA CO.: San Jose, XI-30-59, ♂ ♂ ♀ ♀ r.f. moldy bark of flowering locust, emgd. I-18 to II-8-60 (L. B. McNelly, JAP 60A2).

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